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1 **Field emission characterisation of silicon tip arrays coated with GaN diamond nanoparticle cluster**
Hajra, M.; Chubun, N.N.; Chakhovskoi, A.G.; Hunt, C.E.; Liu, K.; Murali, A.; Risbud, S.H.; Tyler, T.; Zhirnov, V.;
Vacuum Microelectronics Conference, 2001. IVMC 2001. Proceedings of the 1⁴ International , 12-16 Aug. 2001
Pages:121 - 122

[Abstract] [PDF Full-Text (116 KB)] IEEE CNF

L5 ANSWER 2 OF 3 INSPEC (C) 2005 IEE on STN
AN 2003:7626164 INSPEC DN A2003-12-6170J-029; B2003-06-2520D-105
TI Evaluation of **nanopipes** in **GaN** films by localized avalanche breakdown.
AU Ohkubo, M. (Fukui Univ., Japan)
SO Compound Semiconductors 2001. Proceedings of the Twenty-Eighth International Symposium on Compound Semiconductors
Editor(s): Arakawa, Y.; Hirayama, Y.; Kishino, K.; Yamaguchi, H.
Bristol, UK: IOP Publishing, 2002. p.831-6 of xxxi+855 pp. 16 refs.
Conference: Tokyo, Japan, 1-4 Oct 2001
ISBN: 0-7503-0856-7
DT Conference Article
TC Experimental
CY United Kingdom
LA English
AB Defects in **GaN** layers grown by **metal** organic chemical vapor deposition (MOCVD) have been investigated by generating etch pits. Using scanning electron microscopy (SEM), etch pits are found to form on the surface of **GaN** layers by localized avalanche breakdown using NaOH electrolyte. It is found that these etch pits correspond to **nanopipes** in **GaN** layers. The **nanopipes** etching by localized avalanche breakdown is found to become a simple method to detect **nanopipes** in **GaN** layers.
CC A6170J Etch pits, decoration, transmission electron-microscopy and other direct observations of dislocations; A8115H Chemical vapour deposition; A6855 Thin film growth, structure, and epitaxy; A7220H High-field transport and nonlinear effects (semiconductors/insulators); A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A7360L Electrical properties of III-V and II-VI semiconductors (thin films/low-dimensional structures); A7750 Dielectric breakdown and space-charge effects; B2520D II-VI and III-V semiconductors; B0520F Chemical vapour deposition; B2550E Surface treatment (semiconductor technology); B2810D Dielectric breakdown and discharges
CT AVALANCHE BREAKDOWN; CRYSTAL DEFECTS; CURRENT DENSITY; DISLOCATION DENSITY; ETCHING; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; MOCVD; NANOSTRUCTURED MATERIALS; NANOTECHNOLOGY; SCANNING ELECTRON MICROSCOPY; SEMICONDUCTOR EPITAXIAL LAYERS; SEMICONDUCTOR GROWTH; VAPOUR PHASE EPITAXIAL GROWTH; WIDE BAND GAP SEMICONDUCTORS
ST **GaN films**; **nanopipes detection**; localized avalanche breakdown; **GaN layers growth**; **metal organic chemical vapor deposition**; MOCVD; etch pits; scanning electron microscopy; SEM; NaOH electrolyte; **anodic current density**; **GaN**; Al2O3; NaOH
CHI GaN bin, Ga bin, N bin; Al2O3 sur, Al2 sur, Al sur, O3 sur, O sur, Al2O3 bin, Al2 bin, Al bin, O3 bin, O bin; NaOH ss, Na ss, OH ss, H ss, O ss
ET Ga*N; GaN; Ga cp; cp; N cp; H*Na*O; NaOH; Na cp; O cp; H cp; V; Al*O; Al2O3; Al cp; Ga; Al2O; Al; O; Na; H*O; OH

L5 ANSWER 3 OF 3 INSPEC (C) 2005 IEE on STN
AN 2002:7165288 INSPEC DN B2002-03-2550N-003
TI Two-dimensional lateral superlattices of nanostructures: Nonlithographic formation by **anodic** membrane template.
AU Jianyu Liang; Chik, H.; Yin, A.; Jimmy Xu (Div. of Eng., Brown Univ., Providence, RI, USA)
SO Journal of Applied Physics (15 Feb. 2002) vol.91, no.4, p.2544-6. 10 refs.
Doc. No.: S0021-8979(02)06304-1
Published by: AIP
Price: CCCC 0021-8979/2002/91(4)/2544(3)/$19.00
CODEN: JAPIAU ISSN: 0021-8979
SICI: 0021-8979(20020215)91:4L.2544:DLSN;1-B
DT Journal
TC Practical; Experimental
CY United States
LA English

AB A nonlithographic technique that utilizes highly ordered **anodized** aluminum oxide porous membrane as template is presented as a general fabrication means for the formation of an array of vastly different two-dimensional lateral superlattices structures. Hexagonal close-packed **nanopore** arrays were fabricated on Si, GaAs, and **GaN** substrates via reactive ion etching. Quantum dot arrays of various metals and semiconductors were formed through evaporation and subsequent etching. The two-dimensional lateral superlattice structures fabricated using this method are of a high level of ordering, uniformity, and packing density. The diameter and periodicity of the nanostructures are determined by the features of the original alumina membrane, which can be adjusted by varying the **anodization** conditions.

CC B2550N Nanometre-scale semiconductor fabrication technology; B2530C Semiconductor superlattices, quantum wells and related structures; B2550E Surface treatment (semiconductor technology)

CT **ANODISATION**; MEMBRANES; NANOTECHNOLOGY; POROUS MATERIALS; SEMICONDUCTOR QUANTUM DOTS; SPUTTER ETCHING

ST two-dimensional lateral superlattices; nanostructures; nonlithographic formation; **anodic membrane template; highly ordered anodized aluminum oxide porous membrane; hexagonal close-packed nanopore arrays**; reactive ion etching; **metal quantum dot arrays**; semiconductor quantum dot arrays; evaporation; packing density; **nanostructure periodicity; nanostructure diameter; anodization conditions**; Si; GaAs; **GaN**; Al2O3

CHI Si sur, Si el; GaAs sur, As sur, Ga sur, GaAs bin, As bin, Ga bin; GaN sur, Ga sur, N sur, GaN bin, Ga bin, N bin; Al2O3 bin, Al2 bin, Al bin, O3 bin, O bin

ET Si; As*Ga; As sy 2; sy 2; Ga sy 2; GaAs; Ga cp; cp; As cp; Ga*N; GaN; N cp; Al*O; Al2O3; Al cp; O cp; As; Ga; N; Al2O; Al; O

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L3 0 L1 AND L2
L4 88862 NANO##########
L5 3 L1 AND L4

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L6 ANSWER 1 OF 1 CA COPYRIGHT 2005 ACS on STN
AN 140:366181 CA
ED Entered STN: 20 May 2004
TI Structure of assemblies of **metal nanowires** in mesoporous alumina membranes studied by EXAFS, XANES, x-ray diffraction, and SAXS
AU Benfield, Robert E.; Grandjean, Didier; Dore, John C.; Esfahanian, Hamid; Wu, Zhonghua; Kroell, Michael; Geerkens, Marcus; Schmid, Guenter
CS Functional Materials Group, School of Physical Sciences, University of Kent, Canterbury, CT2 7NR, UK
SO Faraday Discussions (2003), Volume Date 2004, 125, 327-342
CODEN: FDISE6; ISSN: 1359-6640
PB Royal Society of Chemistry
DT Journal
LA English
CC 76-2 (Electric Phenomena)
AB Mesoporous alumina membranes ("**anodic** aluminum oxide", or "AAO") are made by **anodic** oxidation of aluminum **metal**. These membranes contain hexagonal arrays of parallel non-intersecting cylindrical pores perpendicular to the membrane surface. By varying the **anodization** voltage, the pore diams. are controllable within the range 5-250 nm. The authors have used AAO membranes as templates for the electrochem. deposition of metals within the pores to produce **nanowires**. These represent assemblies of one-dimensional quantum wires with prospective applications in electronic, optoelectronic, and magnetic devices. Detailed characterization of the structures of these **nanowire** assemblies on a variety of length scales is essential to understand their phys. properties and evaluate their possible applications. The authors have used EXAFS, XANES, WAXS, high energy x-ray diffraction, and SAXS to study their structure and bonding. In this paper, the authors report the results of their studies of four different **nanowire** systems supported in AAO membranes. These are the ferromagnetic metals iron and cobalt, the superconducting **metal** tin, and the semiconductor gallium nitride. Iron **nanowires** in pores of diameter over the range 12 nm-72 nm are structurally very similar to body centered cubic bulk iron. They have a strong preferred orientation within the alumina pores. Their XANES shows significant differences from that of bulk iron, showing that the electronic structure of the iron **nanowires** depends systematically on their diameter Cobalt **nanowires** are composed of a mixture of hcp. and face centered cubic phases, but the ratio of the two phases does not depend in a simple way on the pore diameter or preparation conditions. In bulk cobalt, the face centered cubic β-phase is normally

stable only at high temps. Strong preferred orientation of the c-axis in the pores was found. Tin **nanowires** in alumina membranes with pore diams. between 12 nm and 72 nm have a tetragonal β-structure at ambient temperature and also at 80 K. Magnetic susceptibility measurements show that they are diamagnetic, and become superconducting at the same temperature as bulk tin (3.7 K). Gallium nitride **nanowires** have been prepared in alumina membranes with pore diameter 24 nm by a novel method. Gallium nitrate was deposited in the pores from aqueous solution and thermolyzed at 1000° to form Ga2O3, which was reacted with ammonia at 1000°. The **GaN nanowires** have the wurtzite structure. Preparation at 1150° led to the incorporation of aluminum in the **GaN**. The mesoscopic ordering of the pores in the AAO membranes and their filling by **metal nanowires** has been studied by SAXS, which shows patterns of Bragg peaks arising from the pore arrays. Addnl., the cobalt **nanowires** have been the subject of an initial ASAXS study.

ST structure assembly **metal nanowire** mesoporous alumina membrane

IT Porous materials
(mesoporous; structure of assemblies of **metal nanowires** in mesoporous alumina membranes studied by EXAFS, XANES, x-ray diffraction, and SAXS)

IT Membranes, nonbiological
Nanowires
(structure of assemblies of **metal nanowires** in mesoporous alumina membranes studied by EXAFS, XANES, x-ray diffraction, and SAXS)

IT 1344-28-1, Aluminum oxide (Al2O3), uses
RL: NUU (Other use, unclassified); USES (Uses)
(structure of assemblies of **metal nanowires** in mesoporous alumina membranes studied by EXAFS, XANES, x-ray diffraction, and SAXS)

IT 7439-89-6, Iron, uses 7440-31-5, Tin, uses 7440-48-4, Cobalt, uses 25617-97-4, Gallium mononitride
RL: TEM (Technical or engineered material use); USES (Uses)
(structure of assemblies of **metal nanowires** in mesoporous alumina membranes studied by EXAFS, XANES, x-ray diffraction, and SAXS)

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☐	L2	nano$5	86194
☐	L1	(gallium adj nitride)or gan	21854

FIELD EMISSION CHARACTERISATION OF SILICON TIP ARRAYS COATED WITH GAN AND DIAMOND NANOPARTICLE CLUSTER

M.Hajra[1], N.N.Chubun[1], A.G.Chakhovskoi[1], C.E.Hunt[1], K.Liu[1], A.Murali[2], S H. Risbud [2]
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ABSTRACT

Wide band gap materials show promise for applications in coating of field emission tips. Recently nanocrystalline hexagonal GaN crystallites as small as 5 nm average diameter have been formed using reactive laser ablation of gallium metal in a nitrogenating ambient. In this paper we have investigated the performance of ungated emitter.

Silicon tip arrays coated by dielectrophoresis of gallium nitride nanoparticles or nanocrystalline diamond clusters from an ethanol suspension. The emitters were evaluated and compared before and after the surface treatment using SEM images and I-V measurements in the diode configuration. The phosphor screen, used as the anode was spaced nominally 70 μm from the cathode. A field emission characteristics were measured in a high-vacuum chamber at a pressure range between 10^{-5} and 10^{-8} Torr. The results suggest that the emitters benefit from coating the surface with nanocrystalline diamond clusters in terms of reduction in the turn on voltage and increase in the uniformity of emission in low voltage operation. The long-term emission stability was studied over a period of 90 hrs.

INTRODUCTION

The presence of adsorbed species on the surface of the field-emitter tip can remarkably influence the behavior of electron emission based devices. The presence of the surface contaminants leads to unstable cathode operation. The desirable cathode surface is one that is chemically inert and has a low workfunction. Hence potentially chemically inert emitter-tip overcoatings with wide band gap materials are preferred for a field emission system.

The GaN or diamond nanoparticle cluster is deposited on the surface of the silicon emitters using dielectrophoresis technique. The device configuration considered for the surface treatment of the emitters is the "bed of nails" which is an array of un-gated single-crystal Si emitters placed in an area of 4 cm^2 with a tip-to-tip spacing of 6μm. The emitters were formed from p-type (1-10Ωcm) Si (100) substrates by the subtractive tip fabrication process.

In this work, first results on emission from silicon emitters coated with nano GaN particle clusters are reported. We studied the field emission characteristics and emission stability before and after the emitter surface is coated with GaN nanoparticles or nanocrystalline diamond clusters over an operating cycle of 90 hrs.

0-7803-7197-6/01/$10.00 © 2001 IEEE

RESULTS AND DISCUSSION

We tested the emission properties of the cathodes in a diode configuration. The packaging of the cathodes containing the array of ungated Si-tips for testing in a high vacuum environment is done by placing quartz spacers, 60 – 70 μm thick between the cathode and the phosphor screen, which acts as an anode.

Both the coated cathodes show an improvement in the long-term stability fluctuation as seen from the Fig 1. Cathodes coated with GaN nanoparticles clusters show significant improvement in the current. With the cathodes coated with GaN nanoparticle cluster, the current is more stable when compared with cathodes coated with diamond nanoparticle cluster. The improvement in the current stability is mainly due to the chemically inert intrinsic behavior of diamond and gallium nitride. It acts as a protective layer for the tip from ion bombardment.

CONCLUSION

In this paper we have studied the behavior of the cathodes coated with GaN nanoparticle and nanocrystalline diamond cluster over an operating cycle of 90 hrs. A comparative study show that emitters coated with GaN nanoparticle cluster show significant improvement in the current fluctuation. Both the coated cathodes show a stable operation during the course of this experiment. Further analysis of the current stability from both these cathodes are being studied

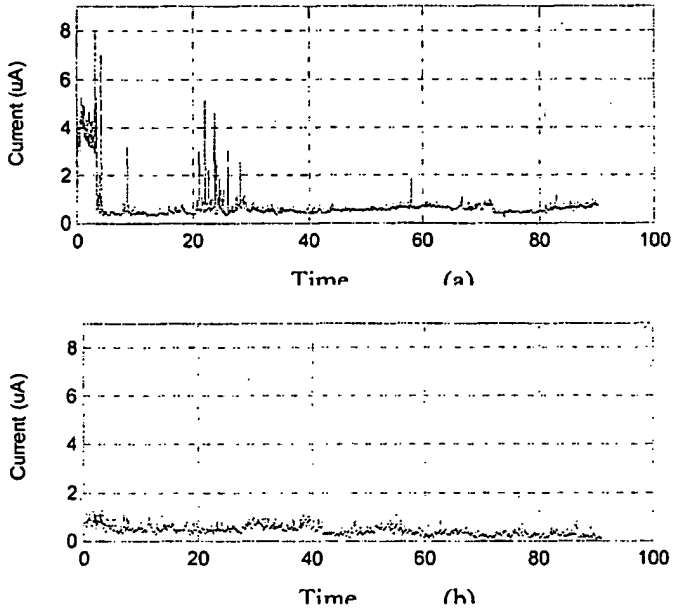

Fig.1 I- characteristics observed over an operating period of 90 hrs for the cathode treated with (a) GaN nanoparticle clusters (b) with nanocrystalline diamond clusters